620191DA

Memorandum For : Chief RED

25X1 Attention : [redacted]

Subject : Preliminary Acceptance Test Results.

1. On 11 Sept 1972 it was noted that the dark spot in the left tracking light source had become worse. The Brightness gradient was measured and the results showed that the brightness at outer edges of the high intensity area are as much as 60% greater ~~brighter~~ than the center of the area. Specifications state that ±20% is the maximum allowable. Further investigation has narrowed the probable cause of the malfunction to the Condenser System. Interchanging of fresnel lenses and lamps did not solve the problem. This malfunction needs to be fixed before testing can continue.

2. The Color Temperature as measured at the viewing surface is out of specification. The trouble seems to lie both with the filters and with the lamps. Spectral qualities with both filters and lamps varies to such an extent that up to 1,900 K color temperature differences have been measured (5150K to 7050K) with

Declassification Review by NGA/DoD

the 80BCC10B filters and lamps [redacted] intended to 25X1
put in this equipment. The attached Chart shows
the various color temperatures and Color rendering indexes for
the measurements taken. All these measurements were taken
on the Right tracking light source.

Color Temperature (C.T.)
and
Color Rendering Index (C.R.I)

Lamp	Filter	Brightness (fL)	C.T. (K)	C.R.I.
USA90	80BCC10B (Right)	25,000 fL	5150 K	92.5
"	" (Left)	25,000	5329	92.5
"	" (Additional)	24,000	6127	91.5
"	80B CC 10B Gelatin	22,000	5000	92.5
"	80B CC 05B Gelatin	24,000	5000	90.0
"	80B Gelatin	29,000	4850	90.0
"	no filter	107,000	3184	90.5
USA89	80BCC10B (RIGHT)	25,000 fL	5850 K	95.5
"	" (Left)	25,000	6050	95.5
"	" (Additional)	23,000	7050	91.5
"	80BCC10B Gelatin	22,000	5750	93.0
"	80BCC05B Gelatin	24,000	5550	92.0
"	80B Gelatin	29,000	5350	90.0
"	no filter	110,000	3550	85.0

Note: (Right), (Left), and (Additional) refers to the ready made filters, Left and Right were provided with the equipment when delivered to NPIC and Additional given to me on 11 Sept 72. The remainder of the filters put together, during testing, from gelatin filters (80B, CC10B and CC05B) also provided on 11 Sept 72. The Lamp, USA90, was also provided on 11 Sept 72. The Lamp, USA89, came with the equipment and was originally positioned in the right tracking light source. A third lamp, which was originally in the left tracking light source, burned out on 14 Sept 72.

Rec'd 9/19/72
BBA
620191 DA

25X1 [redacted]

5:40PM

NO. 460 15 SEPTEMBER 1972

25X1 TO: [redacted] FROM: [redacted] 25X1

ILLEGIB

RE: HILS

LAMP	FILTER	BRIGHTNESS (FL)	CT (°K)
USA 90	80BCC10B (RIGHT)	2[illegible],000	5150
USA 90	80BCC10B (LEFT)	25,000	5[illegible]
USA 90	80BCC10B (ADDNL)	[illegible]4,000	6[illegible]7
USA 90	80BCC10B (GELATIN)	2[illegible],000	5[illegible]
USA 90	80BCC05B (GELATIN)	24,000	5[illegible]00
USA 90	80B (GELATIN)	29,000	4[illegible]50
USA 90	NONE	107,000	[illegible]1[illegible]4
USA 89	80BCC10B (RIGHT)	25,000	5[illegible]
USA 89	80BCC10B (LEFT)	25,000	6050
USA 89	80BCC10B (ADDNL)	23,000	7050
USA 89	80BCC10B (GELATIN)	22,000	5750
USA 89	80BCC05B (GELATIN)	24,000	5550
USA 89	80B (GELATIN)	29,000	5350
USA 89	NONE	110,000	3[illegible]0

[redacted]

RIGHT, LEFT AND ADDITIONAL REFERS TO THE READY MADE FILTERS. LEFT AND RIGHT WERE PROVIDED WITH THE EQUIPMENT, AND THE ADDITIONAL FILTER, THE GELATIN FILTERS, AND THE USA 90 LAMP WERE ALL DELIV[illegible] BY [redacted] ON 11 SEPTEMBER 1972. THE USA 89 LAMP WAS DELIVERED WITH THE EQUIPMENT AND WAS ORIGINALLY POSITIONED IN THE RIGHT S[illegible]. THE LAMP ORIGINALLY ON THE LEFT SIDE BURNED OUT 14 SEPTEMBER [illegible].

THERE IS A DARK SPOT IN THE LEFT LIGHT SOURCE. THE GRADIENT [illegible] 60% WHICH IS 40% OVER SPEC. WE THINK IT MIGHT BE ALIGNMENT.

I WILL BE OUT OF TOWN NEXT MONDAY, 18 SEPT., SO IF YOU HAVE [illegible] FURTHER QUESTIONS, PLEASE CONTACT [redacted] 25X1

EOT
F

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Approved For Release 2005/02/17 : CIA-RDP78B05171A000400020007-4

25X1

620191DA

APPLICATION OF ELH TUNGSTEN HALOGEN LAMP TO A WIDE FIELD MICROSTEREOSCOPE ILLUMINATOR

25X1

A six-inch long tungsten-halogen microscope illuminator produces a three inch diameter, variable intensity, 25,000 ft. lambert, daylight spot suitable for use with microstereoscope examination of aerial films.

Introduction

When large aerial photographs on 9 inch film, as an example, are analyzed the photo-analyst utilizes a large light box for illumination over which he transports the film. (Figure 1). He makes his observations with a microstereoscope as an optical aid which in most cases has a basic zoom pod. In scanning the film, the microscope is set at magnifications as low as 3.0 to 4x and covers a field slightly less than 3 inch diameter. The analyst surveys the film for areas of interest in which may be located the detail he seeks and may examine them under high magnifications, possibly 120x. At low microscope magnifications the area covered is much less than the totally illuminated area so that most of the electric power input for lighting is dissipated into illuminating unused portions of the light box.

If a smaller format, say 70mm film, is examined the excess lighted area must be blocked to reduce glare and discomfort to the analyst. We therefore sought a better means of providing illumination which could be made available primarily to the microstereoscope at the point of observation making the analysis more efficient and less fatiguing. Since typical light box viewing surfaces have luminance levels between 2000-3000 ft. lamberts, the losses incurred through a complex microstereoscope and a film density of 2.0 significantly reduces the luminance of the field to the analyst. Increasing the microstereoscope input luminance by concentrating light into a small area could increase the probability of extracting more and possibly critical information from a film.

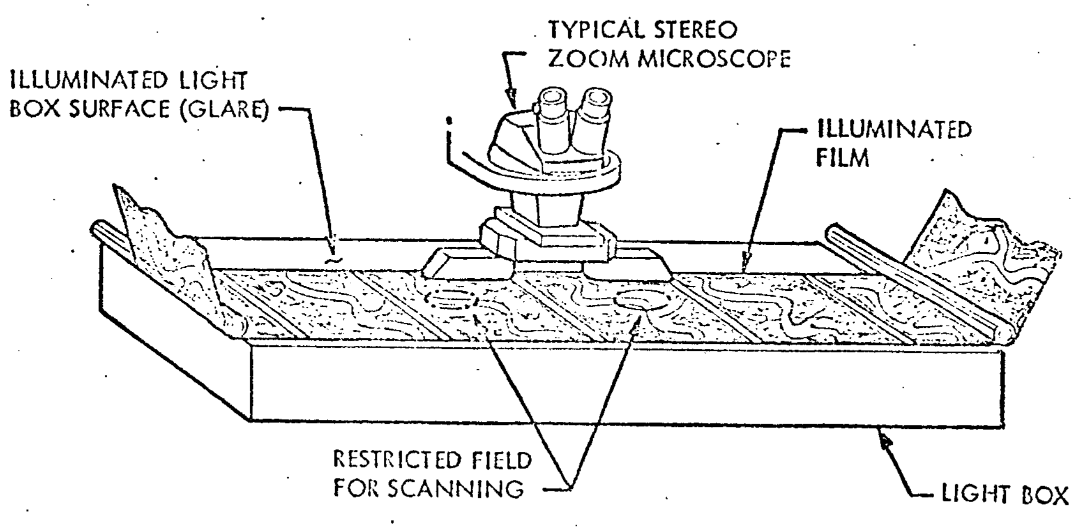


Figure 1. Typical Viewing Light Box with Large Illuminated Area Exposed

25X1

Potential Value

We found upon a brief examination that a concentrated light spot not only can improve lighting utilization but also may exceed the performance of a large light box using fluorescent lamps (Figure 2). For example, high intensity spot illuminator can duplicate many of the light box characteristics.

1. Fully illuminate the instantaneous field of the microscope.
2. Adequately fill the numerical aperture of zoom microscope objectives.
3. Provide daylight quality for color film viewing.
4. Cover the entire format for microscope use by x-y tracking motion.

But note, it provides some added features.

1. Intensity control without change in color.
2. Very much higher luminance levels.
3. Improved color rendering index.
4. Freedom from masking and blocking of unused illuminated viewing area.

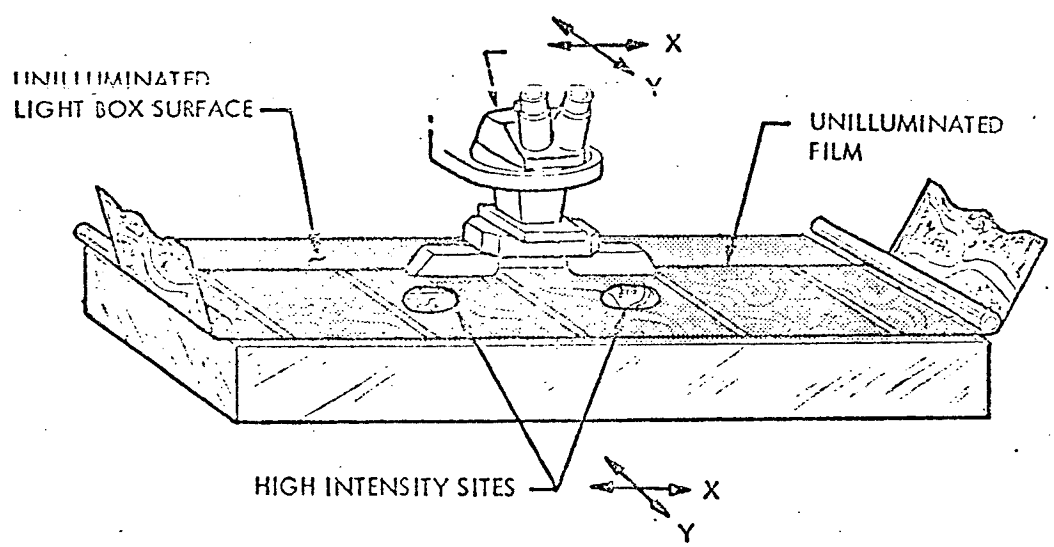


Figure 2. Viewing Surface with Light Spot Concentrated in Field Only

The added features of the high intensity spot appear of significant value to an analyst. Intensity control enables the operator to match the luminance with the film density for maximum comfort. If very high contrast film is under observation with very thin or low density surround areas, it may be desirable to reduce intensity. Where the field is extremely dense it would be desirable to increase the intensity.

25X1 [redacted]

Availability of high luminance levels permits the analyst to see into the shadow areas of dense film. Raising the luminance level by an order of magnitude can shift the eye transfer function into higher spatial frequencies[1] (Figure 3). Although the increased luminance may not significantly improve resolution of high contrast bar targets, it is very useful when increased perception of line or isolated point sources may be important. It is known that limit of perception of single line targets is more affected by luminance than is the limit of resolution[2]. From a 2 second of arc line target such as a wire at high luminance background down to 30 minutes of arc under extremely low luminance background is a factor of 900. The limit of resolution of a bar target under equal values of luminance and contrast may vary from 1.5 minutes arc to 120 minutes of arc for a factor of 80. Thus the angular limit of perception of line targets may decrease as much as 10x faster with increased luminance than does the limit of resolution of a laboratory 3 bar target.

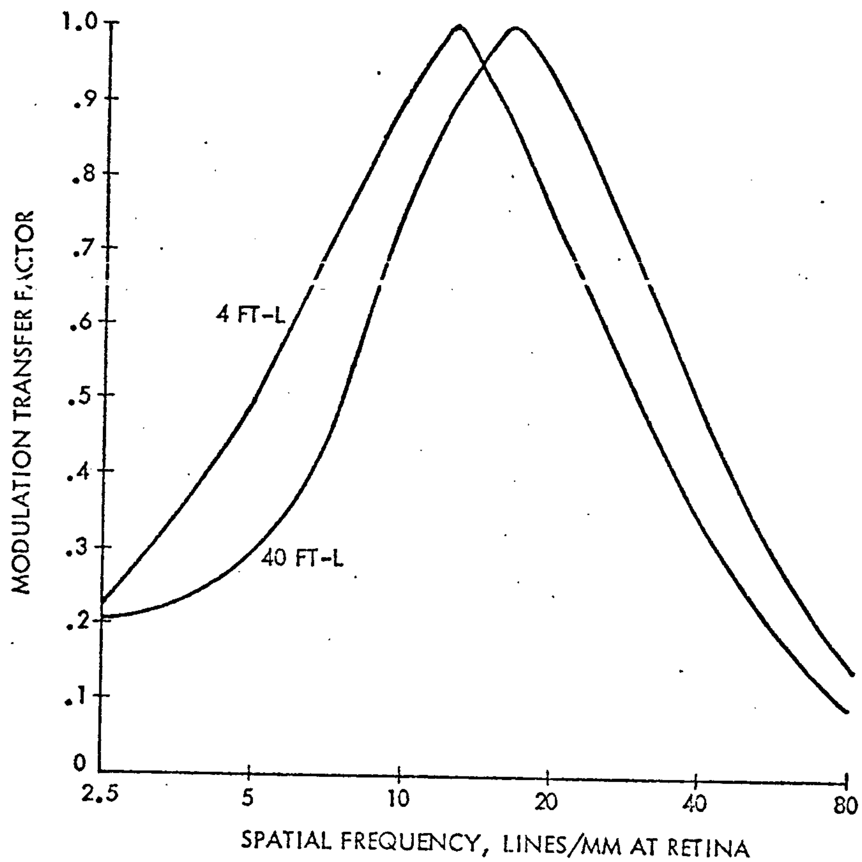


Figure 3. Eye Transfer Functions at 40 ft-L and 4 ft-L as Determined by [redacted] 25X1

Further indications of the advantage in increasing the luminance of the object field[3] are illustrated in Figures 4 and 5. It must be pointed out that most of the illustrations refer to dark objects against a light background and not as seen through optical instruments. It may be cited that the contrast limen is little different with a binocular instrument[4] or for unaided vision and probably can be extended to microscopes with incoherent illumination.

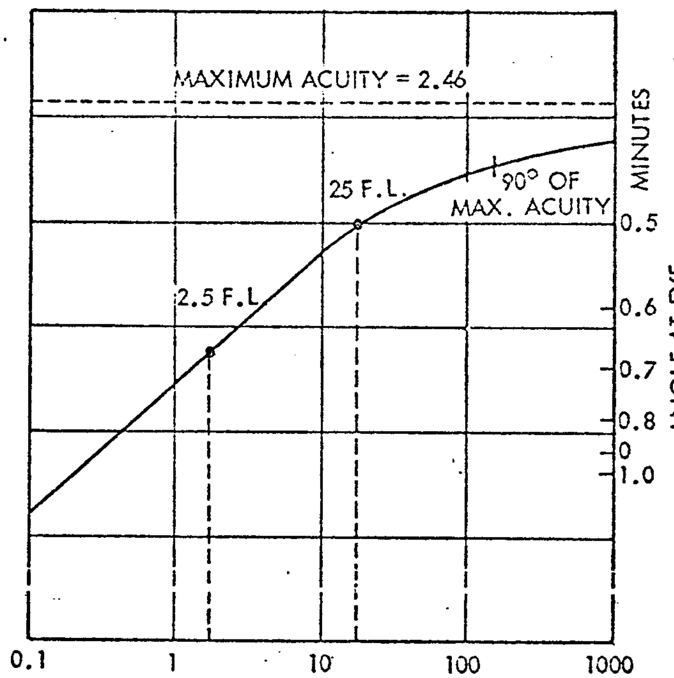


Figure 4. Variation in Visual Size with Background Luminance for a Black Object on a White Background. A = 2.5 f. L., B = 25 f. L.

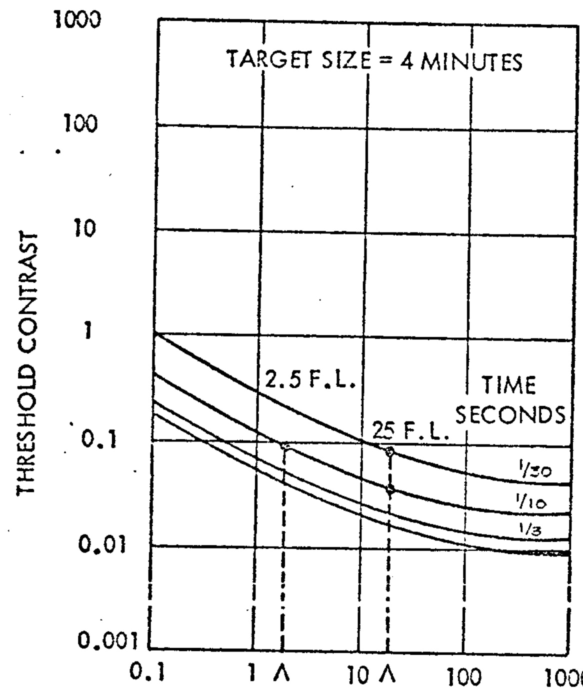


Figure 5. The Relationship Between Threshold Contrast and Background Luminance for Various Exposure Times.

For example, consider a 2500 ft. Lambert lighted area over which an aerial film having a 2.0 density is placed. A visual comparison of the field luminance input to a complex microstereoscope at 120x magnification with the luminance of the same field seen in the ocular indicated a 1.0 equivalent density or 10% transmission. This means a luminance of 2 ft. Lamberts will be seen through the microscope in the dense film area. If a 10x gain in luminance can be achieved then we find interesting information in the above illustrations.

Figure 4 suggests that for a perfectly black high contrast object the critical angle at the eye can be reduced from 0.68 to 0.50 minutes. Figure 5 shows that with 10x increased luminance the perceptible contrast can be reduced approximately $2\frac{1}{4}$x. It also reveals that increasing information can be extracted from a film or the rate of extraction can be increased. For a given contrast threshold, say 0.1, the exposure time required for perception is decreased to 1/3x. The latter suggests that 3x as much information could be gathered by the operator particularly for a familiar type dark object since he can scan the field at a faster rate.

25X1 [redacted]

The high CRI is less apt to distort the color photographs. Sources with high CRI and identical color temperature offer a better reference condition which can be more easily repeated then with various fluorescent lamps having peak spectral outputs.

A small spot concentrated only in the field of the microscope eliminates the need for masking the balance of the unused large illuminated area of a light box. Unused or partially uncovered areas of the light box may illuminate the pupil of the observer from angles as small as 15° from his line of sight into the microstereoscope. The illumination levels may be sufficiently high to introduce disturbing glare and discomfort to the operator. The bright large areas also can strain the analyst each time he removes his eyes from the oculars increasing fatigue unless the areas are completely masked.

There is therefore supporting evidence that a small spot of high intensity properly concentrated may increase the probability of extracting more information from photographic film than with a large area illuminated viewing box having 1/10 the luminance.

Engineering

To generate a high intensity spot in a compact package two types of light sources were compared - one was a highly intense xenon arc, the other was a larger tungsten halogen source. A small xenon arc though intense and of a suitable color temperature was dimensionally too large and required a special power supply. In addition it required collimation and because of the small arc, did not lend itself to a simple intensity control. It would need to be decollimated to fill the numerical aperture of the objectives. Approximately 550 lumens of color corrected 5000°K light was desired in a 3" diameter spot assuming a 3 to 4x gain viewing screen. A 75 watt 3" long compact xenon arc lamp did not provide sufficient light and the higher wattage arc lamps were inconveniently long.

It was at this time that the compact ELH 300 watt tungsten halogen lamp became commercially available. It had very obvious advantages. No special power supply was needed for operation and the physical dimension wass less than any arc. In addition the reflector was dimpled which provided greater uniformity. However, it did introduce the need for color modification and uniformity of illumination in the near field distance of a few inches. The design effort was devoted to the color correction and design of optical configurations necessary to provide intensity control without color or uniformity change and to raise viewing area luminance by an order of magnitude greater than typical light boxes.

Color

Color correction was computed by balancing various filter combinations with a tungsten spectral output of 3350°K. In addition to the KG-1 heat absorber and a 45° aluminized mirror, several computer runs were made using various blue filters 80B, 80C, CC05B and a dichroic cold mirror. The computer system was one normally programmed for National Bureau of Standards in FORTRAN and converted to the [redacted] computer. Prior to taking 25X1 sample runs the two systems were checked against identical sources, one for 3726°K fluorescent lamp and the second for 6400°K fluorescent lamp. Computed color temperature 25X1 difference between NBS and [redacted] was 3° and 8°K respectively and the color rendering index differed by less than half of one percent. We thus assumed the computer techniques were in agreement.

Spectral curves were taken of a 3350°K tungsten lamp through a 3.5 gain diffuser because the diffuser characteristics were unknown. To these the various known filter combinations were added in the computer and the x,y values for the CIE chromaticity along with the color rendering index were computed. Table 1 illustrates the projected values obtained.

Table 1

ELH + HA + Diffuser	°K Color Temp.	x	y	Y	CRI
80B	5058	.345	.363	663	91
80B + CC05B	5202	.340	.356	549	93
80B + CC10B	5424	.334	.347	500	93

Figure 6 illustrates the x,y values of the color corrected ELH on the CIE diagram including some typical fluorescent lamps[3]. The color rendering index (CRI) is 15 to 20% above that of fluorescent lamps having "daylight" quality. From the table the 80B filter cemented between glass was selected in order to achieve the maximum luminance represented by Y in the table.

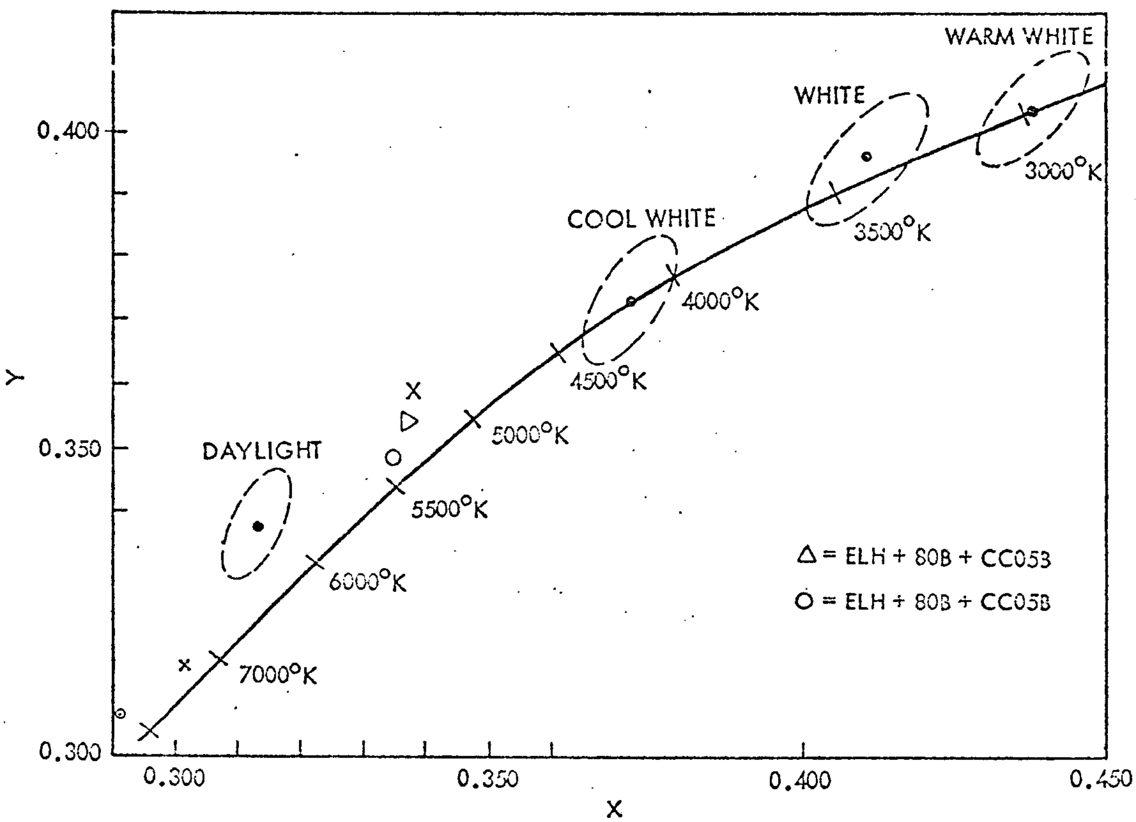


Figure 6. Position of ELH Lamp Modified by Wratten Filters on CIE Diagram and Typical Fluorescent Lamps.

25X1

Optical Configuration

The experimental optical configuration which achieved uniformity and intensity control is illustrated in Figure 7. A 3" diameter beam was projected into the viewing screen having approximately a 3.5x gain (Polacoat 60). To obtain intensity control and uniformity an iris diaphragm was placed near the narrowest bundle of flux projected by the lamp. With experimentation it was displaced slightly toward the lamp for best uniformity. Condenser field lenses were symmetrically oriented about the iris to protect the image of the ELH lamp face on to the Fresnel projection lens. Under these conditions there was severe non-uniformity at the viewing screen since the image consisted of the aperture of the ELH reflector and the halogen bulb itself. A plastic multi lens array mixer was introduced just inside the principal focus of the Fresnel lens which projected a slightly diverging image of the array beyond the screen. The result was a uniform beam at the viewing screen and also an improved polar light output which filled the 0.18 N.A. of typical microstereoscope objectives. For temperature reduction a heat absorber was used to protect the plastic mixer. For color correction the cemented color filter was placed adjacent to the Fresnel lens.

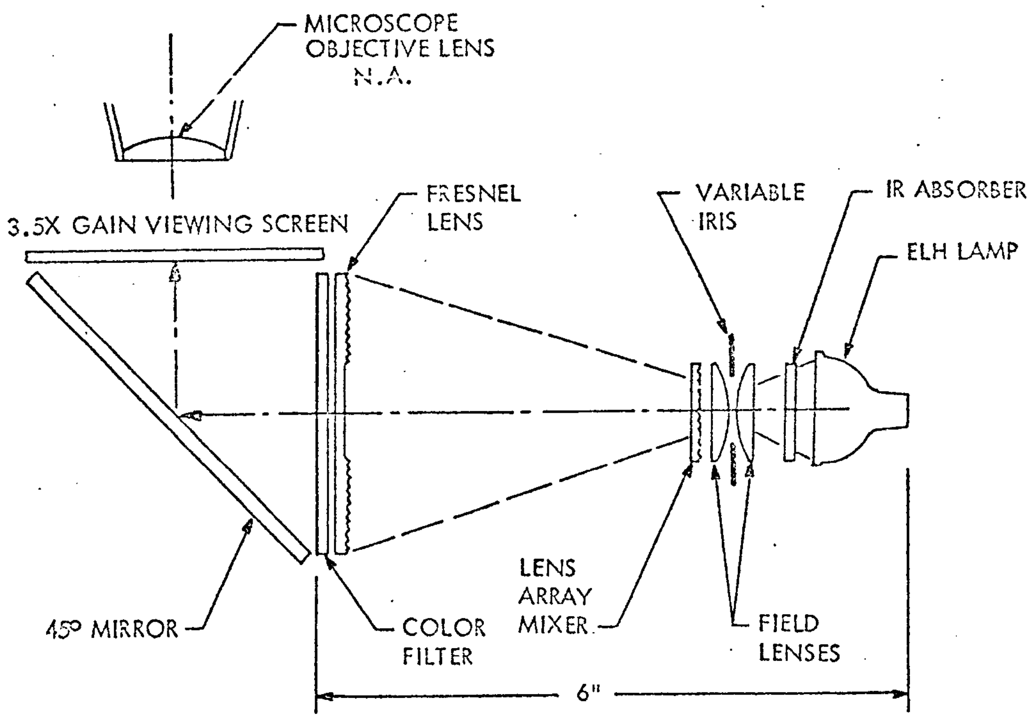


Figure 7. Experimental Configuration of Optical Illuminator

Initial calculation indicated that the ELH could provide the lumens necessary. Before the ELH lamp was obtained illuminance in the 3" spot (.065 sq.ft) incident on the diffusing viewing screen was estimated as follows:

$$E = F \times C \times (0.96)^n \times T_F \times S \times R \times f \times U \times \frac{1}{0.065}$$

where

F	=	Total lumens from lamp	9500
C	=	Lamp collector geometry	0.70
n	=	Number of air/glass surfaces	8
T	=	Luminous transmission of 80B filter	0.32
S	=	Fresnel lens scattering factor	0.9
R	=	Reflection factor	
		45° mirror	0.85
		Lamp reflector	0.90
f	=	Cone ratio lamp to Fresnel $\left(\frac{1.0}{1.15}\right)^2$	0.75
u	=	Utilization factor because of stray light	0.90

Substitution gives

$$E = 7.8 \times 10^3 \text{ foot candle}$$

Screen luminance $B = G \times E$

$G = 3.5$ screen gain and $B = 27{,}000$ ft. Lamberts

The actual result was a $3\frac{1}{4}$ diameter spot of about 5000°K color having a measured luminance value normal to the viewing surface of 25,000 ft. Lamberts. Film temperature rise when placed on this viewer and in ambient room temperature with free air circulation was approximately 22°F for 2.0 density sample.

Conclusion

The two major items which contributed significantly to the design of this microscope illuminator were the ELH tungsten halogen lamp and the lens array used as a mixer. A summary table of characteristics is given in Table II.

Table II

Lamp	ELH 300 watt dichroic reflector
IR Control	KG-1 filter + dichroic IR transmission
Spot Size	3" maximum, 2-3/4" effective
Uniformity	25% fall-off at 2-3/4" diameter
Color	5000°K 500°K
Luminance	1,500 to 25,000 ft.L at 5000°K.

In addition to the light characteristics listed in Table II, it is important to have the numerical aperture of the microstereoscope well filled for optimum image transfer. The modest gain screen illuminated by a divergent beam helps to direct the light more effectively into the microscope objectives. Three microstereoscopes normally used for photo interpretation are the Olympus SZII, Wild M-5, and the B&L 240. These are all characterized by low numerical apertures (less than 0.18) up to 60x magnification. Polar measurements were taken of the spot luminance as a function of angle from normal and compared to microstereoscope numerical apertures. Some further improvement can be anticipated in the design since the multiple lens array used was one easily available commercially and not designed for this specific application.

Figure 8 illustrates that the illuminator does fill a typical microstereoscope objective adequately and should be suitable for use with objectives up to 0.20N.A. It therefore has the potential as an optical aid to microstereoscopes for extracting more information from photographic film then a typical light box viewer.

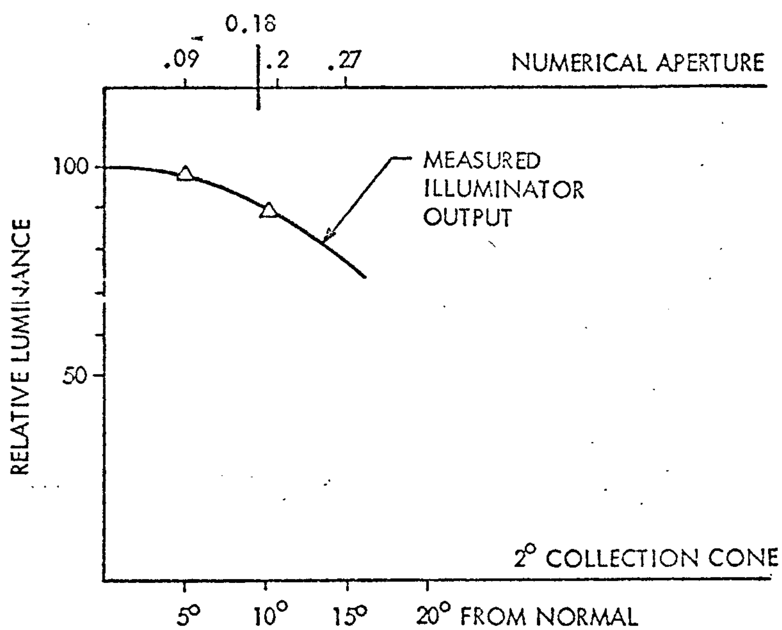


Figure 8. Polar Output of Illuminator as Numerical Aperture Increases

1 Granger, E.M., Cupery, K.N., "An Optical Merit Function (SQF) which Correlates with Subjective Image Judgements" - Photo.Science & Eng. 16, 222, (1972)

2 Boutry, G.A., "Instrumental Optics" Interscience, pg. 259 (1962)

3 IES Illuminating Engineering Handbook (4th Ed), IES (1966)

4 Middleton, N.E. Knowles, "Vision Through the Atmosphere", Univ. of Toronto Press (1963).

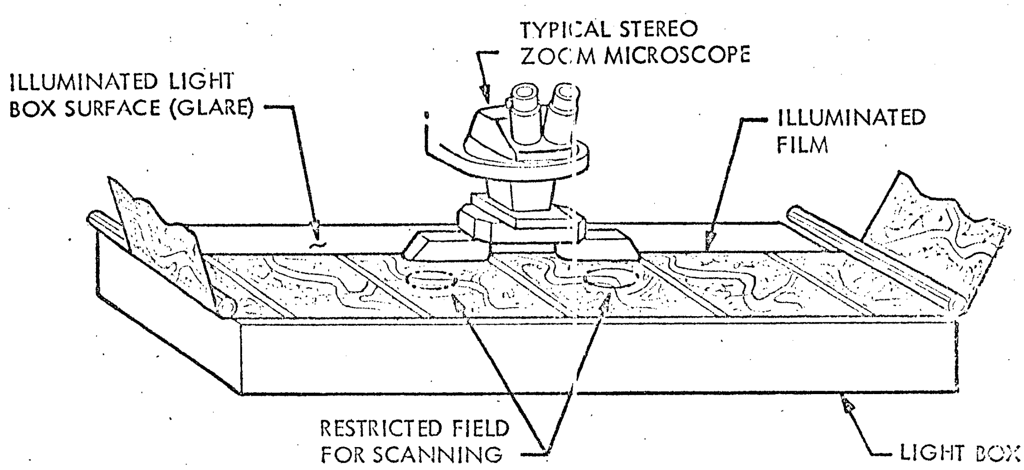
5 Hooker, R.Brian "Comparison of Square Wave Responses of Three Microscopes", Optical Sciences Center, Univ. of Arizona, 15 May 1970.

APPLICATION OF THE ELH TUNGSTEN LAMP INTO A MICROSTEREOSCOPE ILLUMINATOR

DISCUSSION

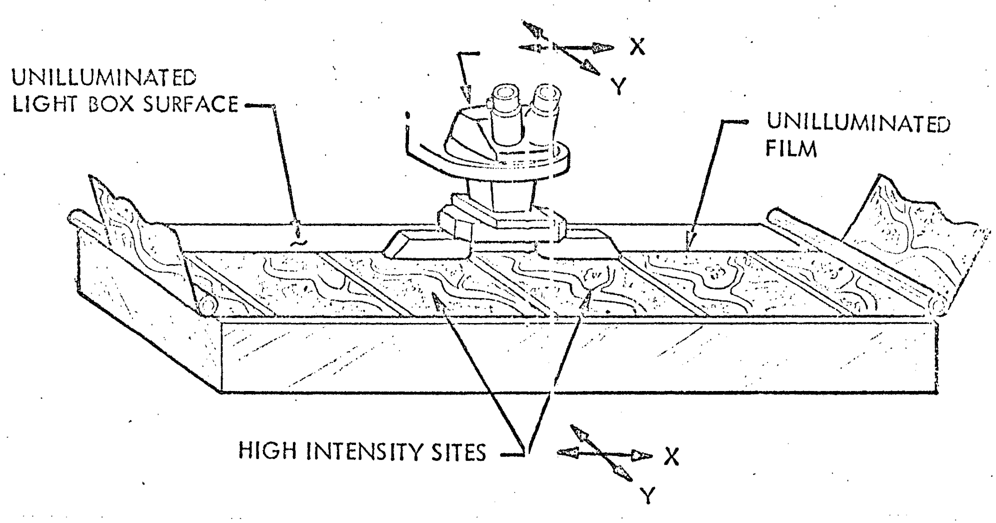
1. ORIENTED FOR USE AS AN AUXILIARY TOOL FOR EXAMINING AERIAL PHOTOGRAPHS
2. POTENTIAL OF THE AVAILABLE HIGH LUMINANCE SPOT FOR THE USER
3. SELECTION OF THE LAMP
4. DESIGN CONSIDERATION
5. OPTICAL CONFIGURATION
6. CHARACTERISTICS OF EXPERIMENTAL ILLUMINATOR

TYPICAL PHOTO ANALYSIS FILM VIEWING LIGHT BOX IS NOT EFFICIENT



1. ILLUMINATION DISTRIBUTED OUTSIDE THE AREA OF MICROSCOPE FIELD.
2. ILLUMINATION ALSO OUTSIDE THE SMALLER FILM WIDTH.
3. RELATIVELY LOW LIGHT LEVELS, 2000-3000 FOOT LAMBERTS.

CONCENTRATED LIGHT SPOT IMPROVES LIGHTING EFFICIENCY



1. CONCENTRATES LIGHT IN MICROSCOPE FIELD.
2. ELIMINATES WASTED LIGHT IN UNUSED PORTIONS OF SURFACE OF FILM.
3. REQUIRES NO MASKING OR BLOCKING UNUSED LIGHTED AREAS TO ELIMINATE GLARE.
4. CAN COVER ENTIRE FILM FORMATS BY X - Y TRACKING WITH MICROSCOPE.

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CONCENTRATED LIGHT SPOT ADDS TO ANALYST PERFORMANCE

BY INCREASING LUMINANCE LEVEL ABOUT ONE ORDER MAGNITUDE

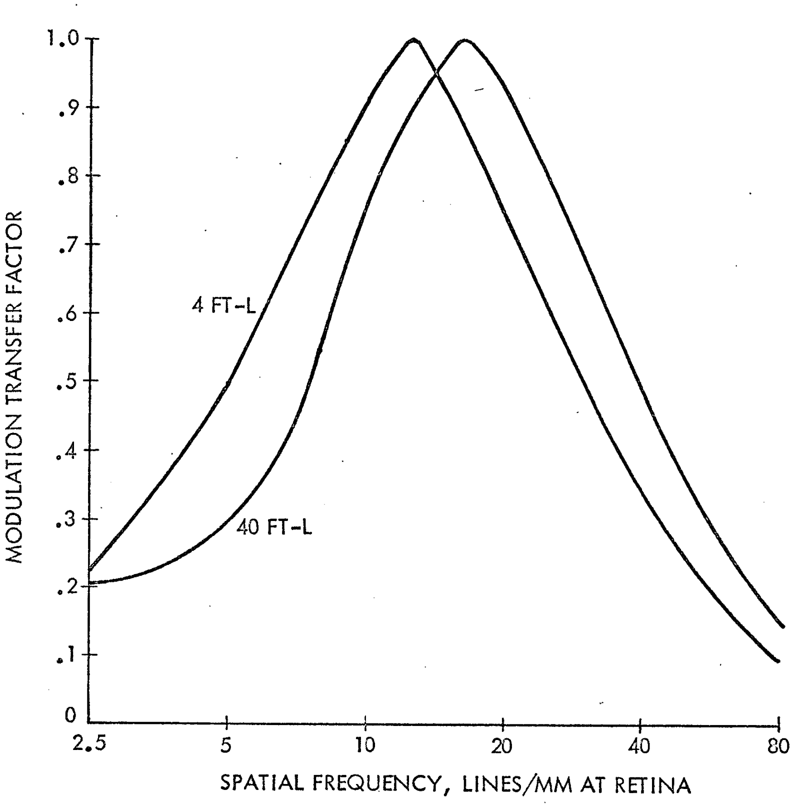
BY IMPROVING COLOR RENDERING INDEX

BY RESTRICTING THE LIGHT TO ONLY THE AREA UNDER ANALYSIS AND REDUCING GLARE

[redacted]

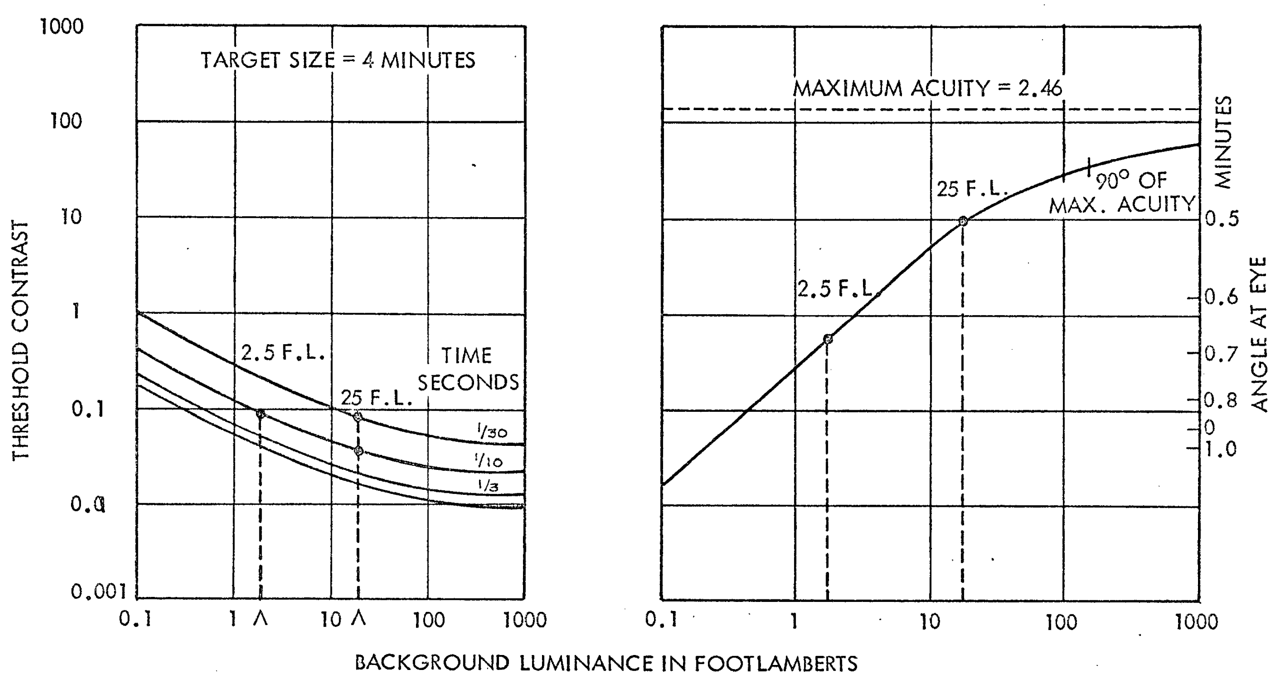
25X1

EYE TRANSFER FUNCTIONS AT 40 FT-L & 4 FT-L AS DETERMINED BY [redacted]



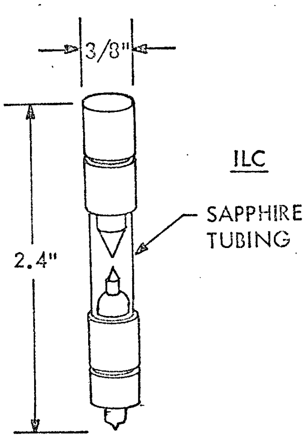
PROBABILITY OF EXTRACTING MORE INFORMATION IS PROMISING

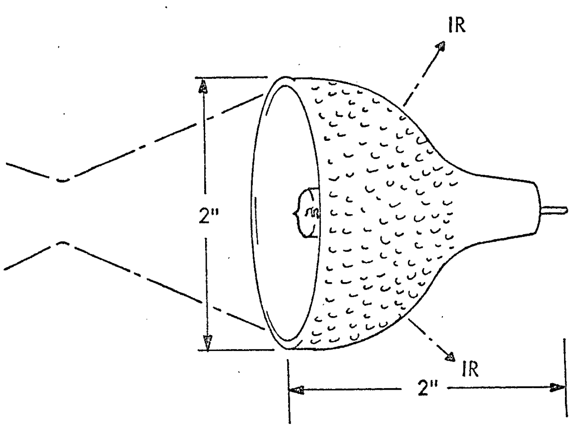
1. MINIMUM PERCEPTIBLE CONTRAST IMPROVES
2. RATE OF EXTRACTING INFORMATION INCREASES
3. VISUAL CRITICAL ANGLE IS FINER



ELH LAMP HAD FAVORABLE CHARACTERISTICS FOR THE ILLUMINATOR

XENON ARC	ELH LAMP (TUNGSTEN)
TYPICALLY LONG FOR LUMENS AVAILABLE	SUITABLE DIMENSIONS
SPECIAL POWER SUPPLY	STANDARD POWER REQUIRED
COMPLEX INTENSITY CONTROL	SIMPLE IRIS CONTROL AT LARGE LIGHT BUNDLE
HIGHLY COLLIMATED	
SPECIAL - 300 WATT LAMP 7000 LUMENS	300 WATT LAMP 9500 LUMENS
REQUIRES SPECIAL DESIGN AUXILIARY REFLECTOR	DIMPLED EFFICIENT DICHROIC COLLECTOR





CHOICE OF ELH LAMP REQUIRED SOLUTION TO TWO MAJOR LIGHTING PROBLEMS

1. 3350°K HALOGEN LAMP COLOR TEMPERATURE MUST BE MODIFIED TO 5000°K

2. AN OPTICAL CONFIGURATION HAD TO BE GENERATED TO PROVIDE

   A. INTENSITY CONTROL WITH CONSTANT COLOR TEMPERATURE

   B. UNIFORMITY ACROSS SPOT DIAMETER AT ALL INTENSITY LEVELS

   C. 25,000 FT. L. LUMINANCE IN THE 3" SPOT

COLOR TEMPERATURE OF 5000°K WAS ACHIEVED BY FILTER SELECTION

SPECTRUM OF 3350°K TUNGSTEN THROUGH DIFFUSER WAS MEASURED

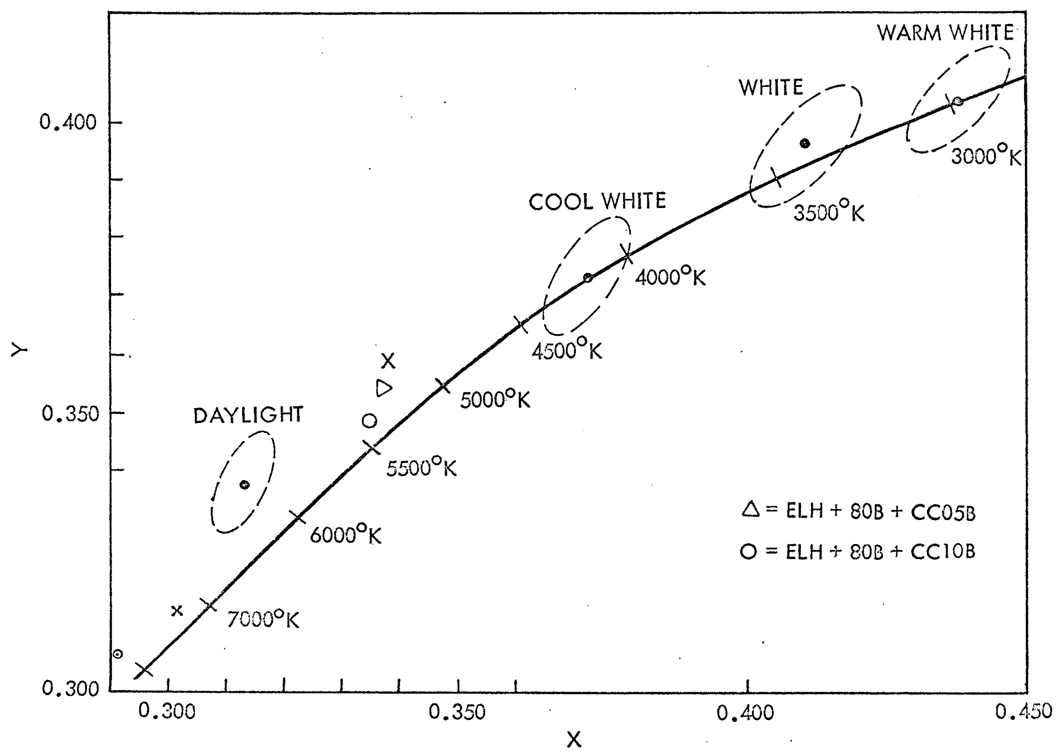
COMPUTER CALCULATIONS GIVE:

HA FILTER +	°K COLOR TEMPERATURE	CRI	Y	CHOICE
80B	5058	91	663	1
80B + CC05B	5202	93	549	2
80B + CC103	5424	93	500	

FLUORESCENT LAMP DATA FROM IES HANDBOOK

DAYLIGHT	6500	78
SGN wh	5200	82

COLOR CORRECTED ELH PRODUCES A SUITABLE 5000°K COLOR TEMPERATURE



25,000 FOOT LAMBERT LUMINANCE WAS CALCULATED FEASIBLE WITH COLOR CORRECTED ELH

$$E = F \times C \times (0.96)^n \times T \times S \times R \times f \times U \times \frac{1}{0.065}$$

E =	ILLUMINANCE AT 3" DIAM (.065 ft^2) SPOT	
F =	LAMP LUMENS	= 9500
C =	LAMP COLLECTOR GEOMETRY	= 0.70
n =	NUMBER OF AIR/GLASS SURFACES	= 8
T =	LUMINOUS TRANSMISSION 80B	= 0.32
S =	FRESNEL LENS SCATTER FACTOR	= 0.90
R =	REFLECTION FACTOR, 45° mirror	= 0.85
	Lamp Reflector	= 0.90
f =	CONE RATIO LAMP TO FRESNEL $\left(\frac{1.0}{1.15}\right)^2$	= 0.75
U =	UTILIZATION FACTOR FROM STRAY LIGHT	= 0.90

SUBSTITUTION

$E = 7.8 \times 10^3$ FOOT CANDLE

SCREEN LUMINANCE $B = G \times E$

$G = 3.5$ SCREEN GAIN $B = 27,000$ F.L.

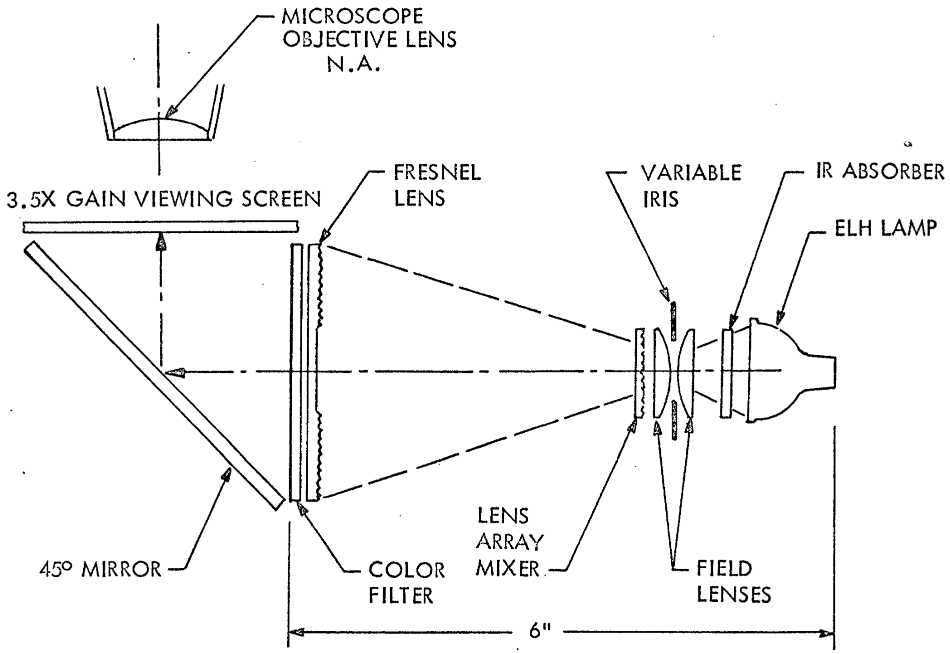
TWO NEW COMPONENTS WERE THE KEYS TO THE OPTICAL CONFIGURATION

THE AVAILABILITY OF THE 300 WATT ELH TUNGSTEN-HALOGEN LAMP FOR COMPACTNESS & EFFICIENCY

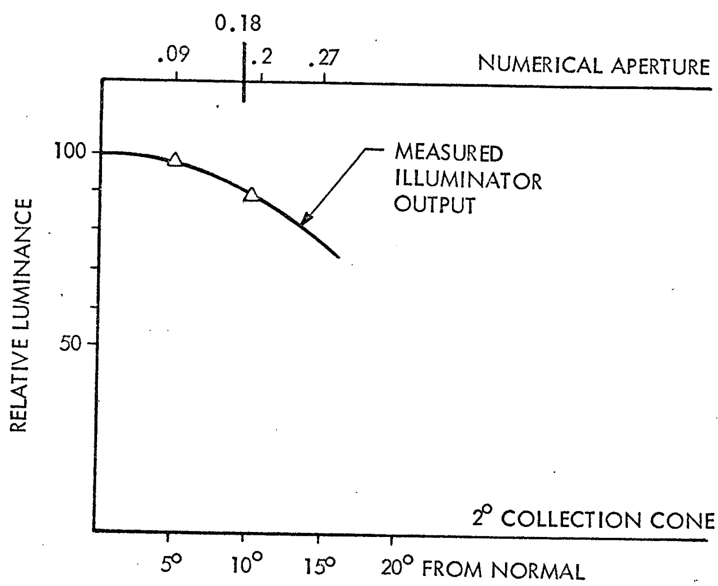
THE USE OF A HIGH DENSITY MULTI LENS ARRAY FOR MIXING

Approved For Release 2005/02/17 : CIA-RDP78B05171A000400020007-4

EXPERIMENTAL CONFIGURATION OF OPTICAL ILLUMINATOR



ILLUMINATOR OUTPUT ADEQUATELY FILLS TYPICAL MICRO STEREOSCOPE N.A.



NOTES

THIS HIGH INTENSITY ILLUMINATOR IS A SUITABLE AUXILIARY TOOL FOR USE WITH MICRO STEREOSCOPES

TABLE OF CHARACTERISTICS

LAMP	ELH 300 WATT DICHROIC REFLECTOR
POWER	115-120 V. 60 Hz
IR CONTROL	KG-1 FILTER + DICHROIC IR TRANSMISSION
SPOT SIZE	3" MAXIMUM, 2-3/4" EFFECTIVE
UNIFORMITY	25% FALL-OFF AT 2-3/4" DIAMETER
COLOR	5000° ± 500°K
LUMINANCE	1,500 to 25,000 F.L. AT 5000°K
N.A.	TO 0.18
CRI	HIGH ~ 91